HUMAN-COMPUTER INTERACTION IN STUDY ROOM RESERVATION SYSTEMS

An Undergraduate Research Scholars Thesis

by

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Submitted to the LAUNCH: Undergraduate Research office at
Texas A&M University
in partial fulfillment of the requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
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May 2021

Major: Computer Science Engineering

RESEARCH COMPLIANCE CERTIFICATION

Research activities involving the use of human subjects, vertebrate animals, and/or biohazards must be reviewed and approved by the appropriate Texas A&M University regulatory research committee (i.e., IRB, IACUC, IBC) before the activity can commence. This requirement applies to activities conducted at Texas A&M and to activities conducted at non-Texas A&M facilities or institutions. In both cases, students are responsible for working with the relevant Texas A&M research compliance program to ensure and document that all Texas A&M compliance obligations are met before the study begins.

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This project required approval from the Texas A&M University Research Compliance & Biosafety office.

TAMU IRB #: 2018-0039D Approval Date: 03/07/2018 Expiration Date: 3/21/2022

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ABSTRACT

Intelligent Room Reservation Systems

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Study rooms provide a key resource for college students. However, many study spaces require reservations ahead of time to manage high demand. A reservation system serves to control the flow and population of a building to limit interaction during a global pandemic. Existing solutions display a lack of user-friendliness that inhibits students' ability to schedule time in a room, effectively restricting them from this resource. This either occurs as a result of using cost-effective but inefficient tools, or as a result of poor design in a proprietary tool.

To address these problems, a prototype of a new interface was developed to bring the idea of the personal scheduling assistant to study room reservation. Historical reservation data from the Zachry Event Management System was gathered to analyze trends, and conducted surveys to identify the most important factors in scheduling for a student user. After developing the application and prototypes of existing solutions, a user story was conducted to evaluate and compare this prototype solution to existing solutions.

The proposed solution succeeded at its goal: to be a better browsing solution than current

systems. While it was not the favorite in all cases, participants found the gradient availability easy to interpret and its weekly view useful for scheduling. The existing solution that showed availability by room and time was simulated in this user study and held strong favor with participants due to clarity and familiarity. This study shows that there is definite potential in integrating more browsing features to scheduling systems. Combined with the accepted, detailed implementation, the proposed and tested solution improves the reservation experience.

DEDICATION

To my family, instructors, and peers who supported me throughout the research process.

ACKNOWLEDGMENTS

Contributors

I would like to thank my faculty advisors, Dr. Tracy Hammond and Dr. Paul Taele, for their guidance and support throughout the course of this research.

Thanks also go to my friends and colleagues and the Computer Science & Engineering department faculty and staff for making my time at Texas A&M University a great experience. Special thanks to my peers who participated in this research.

Finally, thanks to my parents for their encouragement and support throughout my time at Texas A&M.

The historical data analyzed for "Human-Computer Interaction in Study Room Reservation Systems" was provided by Zachry IT.

All other work conducted for the thesis was completed by the student independently.

Funding Sources

This work received no funding.

NOMENCLATURE

Zachry Event Management System	The proprietary web application that the Texas A&M University College of Engineering uses to manage room reservation in the Zachry building
Human-Computer Interaction	The study of computer interface design and use, focusing on how human users interact with the technology
Personal Digital Assistant(PDA)	A handheld computer with access to Internet and Bluetooth, providing portable access to calendars, databases, and other utilities

1. Introduction

1.1 Motivation

Students are not making the most of their opportunities to take advantage of study rooms as learning resources because the current scheduling platform obstructs their ability to easily reserve them. The specific problem that I want to solve with my research and prototype is that current solutions consider the system from the system's perspective instead of from the user's perspective. This is evident in the way that their data is presented to the user. By taking a personal approach to designing my application, I aim to make reserving rooms more effective for students.

There is a wide range of existing reservation systems, from simply talking to a receptionist to more advanced digital solutions. Proprietary digital systems like the Zachry Event Management System have the potential to be more effective and tailored to the building they serve. But these solutions are costly to implement and update. Therefore, developers must be careful in designing these with the correct parameters in mind. Budget-friendlier solutions such as utilizing digital surveys and calendars, on the other hand, may require a lot of hands-on management to function properly. An ideal solution to this problem is both efficient and cheap, and puts the user experience above all else. Spending money on a proprietary system is justified if it fulfills its purpose. Through preliminary surveys, I have found that many users are dissatisfied with the Zachry Event Management System for reasons that are avoidable with a new design.

The visual representation of availability data is the main issue with current systems. The data should be presented in a way that clearly shows the user where possible reservations will fit in their weekly schedule, as opposed to a system that shows the availability by rooms over a span of one day.

1.2 Research Proposal

In the current global climate, it is important to have accessible, digital ways to accomplish scheduling tasks efficiently. In a preliminary survey, I found that student users disfavor aspects of

even the high-tech solutions, including the need to enter lots of specific data. My objective is to develop a prototype application that improves upon the user interaction with existing study room reservation systems by providing suggestions based on limited input.

When designing my algorithm, I analyzed trends in the Zachry Event Management System data I collected and parsed last semester using Python and XML to determine the most important factors for reservation. I designed and implemented my prototype using the waterfall method of development, with design, implementation, and testing stages. I used Figma to create my design sketches. I used Postgresql for the backend application and Ruby on Rails for the Graphical User Interface portion. I utilized resources as recommended by my research advisors for learning about Machine Learning implementations. I was able to complete this project using my personal device and online resources.

1.3 Case Scenarios: Current Solutions

1.3.1 Case Scenario 1: Soonest Available

The user has multiple classes in Zachry on the same day and would like to schedule time in between those classes to work on homework. They just had this idea while leaving the first class. They navigate to the Zachry Event Management System, log in with their university credentials, and are greeted with the default dashboard. They see the "Home" screen, which displays instructions and information. They click "Create a Reservation" and see three template options, as in Figure 1.1 below.

Figure 1.1: Zachry Event Management System

The user is an individual and does not need a large event space, so they select “book now” next to “Reserve a single occupant room in ZACH”. They see a blank results panel and a panel on the left to submit a date and start and end times. There are also options to specify capacity and a room number. The user notices that the current date and a start time close to the current time is already selected, so they press “Submit”. As shown in Figure 1.2 below, the results panel now shows a table, with rows representing rooms and columns representing time. There are grey blocks that show where rooms are currently reserved; these blocks vary in duration and do not all match up neatly with hour or half hour marks. There are also two vertical lines indicating the start and end times. The user scans down this column. The majority of the rooms are at least partially occupied during the selected time slot, but luckily the user spots an open room and clicks the green + button next to the room number.

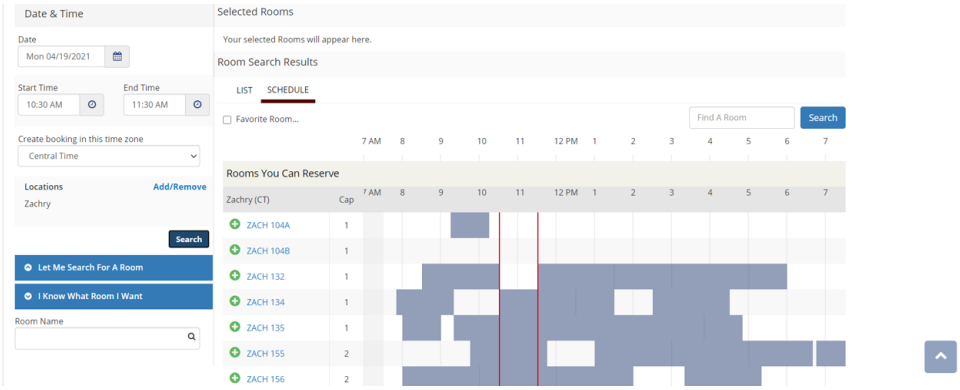

Figure 1.2: Zachry Event Management System

The room is added to Selected rooms and a “Next Step” button appears. The user enters a title for the session, contact information, and a social distancing acknowledgement. The user selects “Create Reservation” and is greeted by a confirmation popup and screen. The user receives a confirmation email and sees options to add the session to their calendar.

1.3.2 Case Scenario 2: Specific Parameters

The user wants to schedule time next week to work on homework. They have a class schedule in graphical, weekly format. They navigate to the Zachry Event Management System, log in with their university credentials, and are greeted with the default dashboard. They navigate to the same template as in the last case scenario. They pick a time on their schedule and enter that time and date into the panel and clicks "Submit". Unfortunately, they find that no rooms are available for that specific window of time. They locate another time that might work for them on their schedule and enter that time and date, and repeat the process until they discover a room available during a time window that also works for their schedule. They complete the reservation process and receive a confirmation email.

1.3.3 Case Scenario 3: Few Parameters

The user has an exam coming up and wants to schedule a study room over the weekend. Today is Thursday. They do not have any plans around which to schedule their study sessions. They navigate to the Zachry Event Management System, log in with their university credentials, and are greeted with the default dashboard. They select the same template as in the last case scenario. They enter a random time on Friday and click "Submit". They see the chart of reserved rooms and look for black spaces, ignoring the vertical lines since the user just wants to browse. The user notices a few times that might work but wants to explore all their options. They enter the date for Saturday, click Submit, and browse again. They repeat this process for Sunday. After struggling to weigh their options, the user decides to pick an afternoon time on Saturday. They enter the time and date, click Submit once again, and complete the reservation process with an available room.

1.4 Case Scenarios: Proposed Solution

1.4.1 Case Scenario 1: Soonest Available

The user has multiple classes in Zachry on the same day and would like to schedule time in between those classes to work on homework. They just had this idea leaving the first class.

They enter the application, log in with their university credentials, and are greeted with the default dashboard. Figure 2.1 below shows what this dashboard should look like.

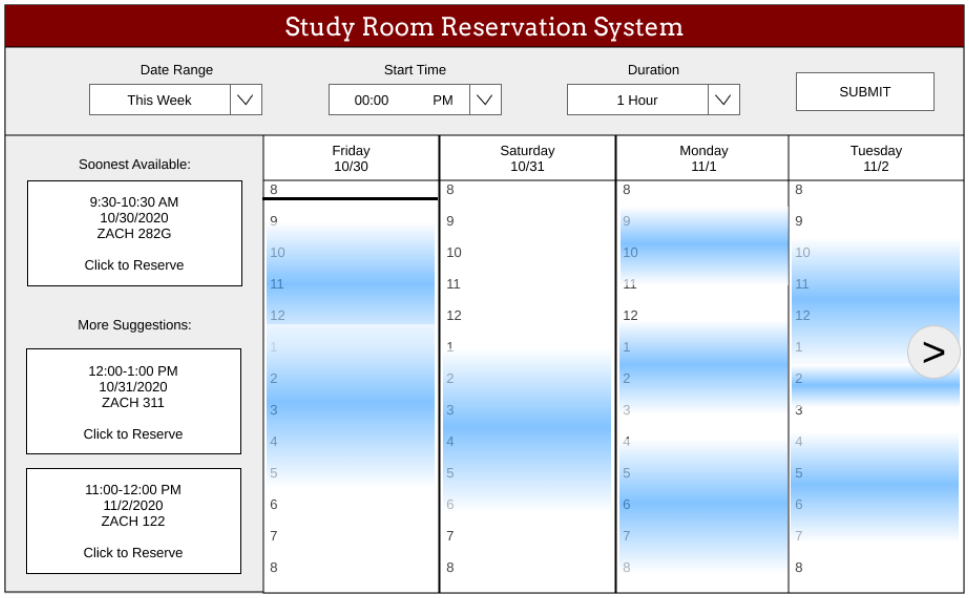

Figure 1.3: Proposed Solution

The user sees today and the next four days represented in weekly calendar format; gradient colors show availability for times, darkest being least available. On the suggestions panel, they see suggested reservation rooms and times; the first suggestion will be an ASAP suggestion; the closest reservation available by time. They click the suggestion card to create the reservation, edit settings such as duration.

1.4.2 Case Scenario 2: Specific Parameters

The user wants to schedule time next week to work on homework. They have a class schedule in graphical, weekly format to reserve around. They enter the application, log in with their university credentials, and are greeted with the default dashboard. They see today and the next three days represented in weekly calendar format; gradient colors show availability for times,

darkest being most available. They press the right-facing arrow in the calendar panel until appropriate dates for next week are shown. The suggestion panel now shows suggestions for next week. They compare their class schedule first to the suggestions, and then to the availability shown in the calendar. Then, they create a reservation by clicking a suggestion or a point on the calendar.

1.4.3 Case Scenario 3: Few Parameters

The user has an exam coming up and wants to schedule a study room over the weekend. Today is Thursday. They do not have any plans around which to schedule their study sessions. They enter the application, log in with their university credentials, and are greeted with the default dashboard. They see today and the next three days represented in weekly calendar format; gradient colors show availability for times, darkest being most available. On the suggestions panel, they see suggestions which may or may not be appropriate for their situation. If a suggestion appears over the weekend for a time that the user likes, they will click that selection, opt to edit settings like duration, and create the reservation. If a suggestion does not appear, they look at the calendar view; since today is Thursday, they will see Saturday and Sunday's availability. Using the information presented to them, they will click on a time to create a reservation, edit settings, and reserve the room. An email confirmation will be sent at the time of scheduling, and a reminder will be sent a day prior to the reservation.

1.5 Related Work

1.5.1 Study Rooms and Current Solutions

Study rooms on campus serve as a crucial resource for students' academic success [1, 2, 3]. A 2015 study showed that utilization of library resources has a significant positive impact on a student's GPA [1]. Additional research has shown that student retention and utilization of library resources were also positively correlated [2]. These studies support the benefits of study rooms to students, such as providing a place to escape distractions of other students, rehearsing presentations, hosting team meetings for group projects, and so on. Furthermore, such rooms provide equitable resources for those who may not have an effective study space in their home or who struggle to focus when working in a public space. For many, success in higher education would be impossible without access to study rooms on campus.

Despite their importance, without an effective way to schedule these spaces, especially at large universities, they become useless to those students. For example, at Fordham University, researchers observed that without a scheduling management system, students would take over rooms for long periods of time that prevented other students from using them [4]. At Fordham University's library, the researchers conducted a study implementing a reservation system using Google Calendars and discovered that although the application was free and easy to set up, it required a lot of hands-on upkeep that may make it impractical for an institution with a small staff or large student population [4].

Meanwhile, the Zachry Engineering Education Complex at Texas A&M University [5] has its own reservation module, the Zachry Event Management System, which allows students to view available times and schedule automatically [6]. With over 20,000 engineering students enrolled in the University's College of Engineering as of the University's 2021–2022 academic year [7], the number of study room spaces in the College's flagship building may not always be enough given the large engineering student body. Despite its many features, users still complained about the usability of this feature. The question of how to design an effective, proprietary solution has been

addressed in numerous studies, especially with regard to how the user experiences the solution [8], [9], [10], [11]. There are clearly many ways to implement a reservation system, and factors like cost, upkeep, and user experience all matter. To make an effective system, the user's needs must be considered above all else [12].

1.5.2 Online Reservation Systems: The H Sovereign Analysis

Nearly every business these days has an online presence. The Internet allows businesses to advertise and interact with a global customer base. This expansion in scope translates to greater profits for businesses and greater convenience for customers. During the COVID-19 pandemic, an online system for transactions has proved essential for businesses to stay afloat [13]. Some businesses simply post information on their websites, such as contact information, menus, or product descriptions. Others offer the ability to purchase products and schedule services. A hotel is a great example of a business that relies on reserving space, similar to how we reserve study rooms at a library.

While an online reservation system for a hotel has become a prerequisite at this point, businesses still must consider the benefits and drawbacks of implementing an online reservation system. The H Sovereign Hotel in Bali conducted a SWOT analysis of its online reservation system to discover how its business was impacted by the online tool [14]. SWOT analysis is a common business tactic wherein you analyze your business to determine its strengths, weaknesses, opportunities, and threats [15], [16]. SWOT analysis is also used in software development, which made it especially applicable to this scenario [17], [18]. Strengths and weaknesses result from internal factors, such as the management personnel and strategies employed at the organization. Opportunities and threats come from external factors, such as the market and competitors in your industry. By defining them, you discover how best to exploit the strengths, improve the weaknesses, capitalize on the opportunities, and react to the threats of your organization [19]. Consistent analysis can help identify failures early so that strategies can be adjusted [20]. The SWOT analysis helped H Sovereign learn important details about the effectiveness of their own operation.

Like most businesses, they observed that the customers found the method convenient and

quick, and overall the method was more effective to the business. They also reaped the benefits of widespread advertisement and profits from last minute reservations [14] They noticed that last-minute cancellations posed a threat to their business, as not only would they lose profits but they may lose their hotel rating due to lack of retention [14]. Lastly, managers noticed that a disadvantage for their employees was that the system's complexity proved more difficult to learn quickly and they perceived less flexibility than before [14]. This raises an important note, that the managers of the website also serve as end users, so developers should consider their interaction when designing the interfaces as well as the customer interactions. Obviously it may not seem like a positive to discover major flaws in a business strategy. However, knowing the problem is the first step to solving it, this analysis effectively points out specific ways that the business will address in the future.

1.5.3 Human-Computer Interaction

Human-computer interaction is an important aspect in the design of computing applications [21], [22]. That is, code for the application may be flawless and the functionality may be efficient, but if the user finds it difficult to use then the project will never live up to its potential [23]. Users today have very little patience when it comes to using websites to shop or look for information. If we cannot find something immediately or struggle with the process, we know there are countless alternatives at the click of a mouse. To hold the user's attention, an application must be intuitive, meaning the user can tell almost instantly how to navigate and use the application without a lot of documentation [24]. This can be accomplished by following standard formats of applications users are familiar with already [25]. For instance, websites typically have their menus across the top or left-hand side of the screen, because that is the direction we typically start with when reading in Western culture. If you placed your menu on the bottom, it may cause unnecessary barriers to the usability of your site. Luckily, barriers like these can be easily discovered through user studies, where participants are interviewed while using an application for the first time. User studies are traditionally used to evaluate software interfaces and are crucial to the development of usable applications [26], [27].

Clear representation of data is critical to an effective user interface. This is especially important to scheduling applications, since we typically use visual aids to help us organize time [28]. A helpful graphical user interface could inform the user of availability trends using ”availability bars.” While useful for scheduling meetings that work for many different people, these gradient visualizations could show the best times to reserve a certain room based on past data [29]. Other representations include grids or continuous streams of time; developers have gotten creative in an effort to implement the most intuitive design possible [30], [31]. While systems like Google Forms [32] or the Zachry Event Management system rely on specific queries, a graphical feature like availability bars would allow for a more browsing experience that may be more appropriate for how some students use a study room. An application that provides for both browsing and specific queries provides accessibility to a larger group of users. This will result in more reservations occurring through the application.

1.5.4 The Personal Assistant

The idea of the personal assistant has become pervasive in our household devices, from Amazon Alexa [33] transcribing your grocery list to Siri [34] suggesting that you check the Youtube app [35] at a certain time of day. These technologies are created to make users' lives easier by eliminating the busywork that comes with routine action. Many of these technologies rely on scheduled routines that you set for them. For example, you can create a list of actions for a Google Home to execute when you say “Good Morning.” You can also adjust a setting on Google Calendar [36] to have it notify you thirty minutes before an event. Intelligent calendar applications have increased in popularity, as they add a personal assistant touch to a necessary service [37], [38], [39], [40].

These features allow you to customize your experience and minimize the effort you have to exert. This type of personal assistant technology is simple to implement, and has been around for years.

Today, if you heard the term “personal digital assistant,” you might think first of Siri or Cortana [41]. However, before these invisible voices, the personal digital assistant was actually

a handheld computer created to put utilities such as calendars, notes, calculators, and more in a portable form for busy workers [42]. PDAs could connect to the Internet and to local databases through Bluetooth; they were especially helpful in data-heavy positions such as nursing in hospitals [42]. These devices predated smartphones with their digital display in handheld form, though they were not used as phones; they were created in the 1980s and popularized in the two decades following [43]. Since their inception, developers have sought to improve the usability of the applications they provided, informing modern handheld software [44]. With these devices available to the public, everyday workers could see how having a custom technology managing their schedule and information could make a great impact on productivity.

Today, personal assistant technologies are expanding to include machine learning Machine learning algorithms analyze historical data, map trends, and make predictions based on those trends. These algorithms become better and better at making their predictions as they receive feedback and more data from the user. Machine learning allows applications to provide insightful suggestions. For example, Gmail uses machine learning to provide auto-fill suggestions as you draft your emails [45]. Furthermore, the iPhone can learn from your activity history to adjust your charging pattern to optimize battery health while you sleep [46]. Just as a good secretary might ask you a question in anticipation of your request, these applications are attempting to automate your tasks. The personal assistant in these technologies is not meant to make decisions for you, but rather to give you the information you need to make complex decisions. As scheduling is one of those complex decisions, a room reservation system can improve user experience by offering suggestions or showing future availability trends.

2. Methods

2.1 Prototype Development

2.1.1 Interface Design

The first step in implementing my proposed solution was to establish a list of features and create a user interface sketch using Figma, a free web-based prototyping tool. In my solution, I wanted to highlight the ability to browse and make the scheduling more intuitive. I achieve the browsing capability in my solution by creating a default view that is available without needing to query first. As seen in Figure 2.1, the view panel shows four days, beginning with the current day. The days are presented as columns similar to those found in calendar applications such as Google Calendars. This choice was made so that this scheduling system aligns with how the users will likely have their own schedules laid out; this similarity will make comparing available rooms with their schedule more intuitive.

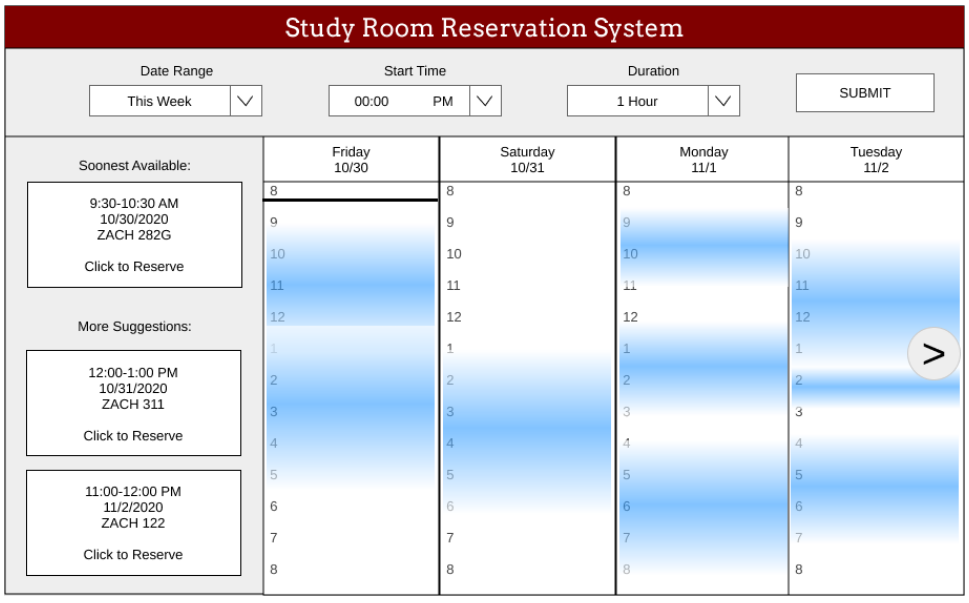

Figure 2.1: Figma Sketch of the main page of my proposed scheduling prototype.

The blue gradients seen on the columns indicate room availability at that time; the darkest end of the spectrum has the most rooms available. These gradients give the user the information they need to make scheduling decisions. The user can click anywhere in the columns to see further details at that time, such as which rooms are available for the selected duration. When clicked, the arrow on the right of the application moves the view to the next four days.

The suggestions panel on the left is how this solution brings in the idea of the personal assistant. Using historical reservation data, the algorithm will create suggestions for rooms and times that are available but tend to be the most popular. The first suggestion will always be the soonest available option. This is designed specifically for the case scenario where a user needs a space for impromptu sessions as soon as possible.

This solution provides the ability to query as well as the ability to browse. The options for querying are Date Range, Start Time, and Duration. Date range will have options for This Week and the ability to select a date. The view will have the selected date as the first column. Start Time will be a time of day, with the default as the current time. Duration will be selected in increments of quarter hours, with the default as one hour. When the Submit button is clicked, the appropriate view will be rendered for Date Range, and the suggestions panel will be rendered to show suggestions that fit the Start Time and Duration parameters given. The query panel does not give the option to search by room, because the room location is not a very important factor for the users. When a reservation is created, the user will be presented with a dropdown list of available rooms for that reservation time and date.

Whether the user clicks on the calendar view or a suggestion card, they will then be taken to a Create Reservation view. Here, they will add information like a title and description for their session, select a room, and accept any acknowledgements necessary regarding the terms of use of the space or any social distancing rules. When they finalize the information and submit the reservation, they will receive a confirmation message in the app and in an email.

2.1.2 *Interface Implementation*

The prototype design was implemented using Ruby on Rails to be evaluated along with two other existing designs during the user study. The implementation of the prototype can be seen below in Figure 2.2. The design shows five days of availability for the reservation system. The rows of these columns represent availability at a certain time. The availability in this implementation is defined as the number of rooms available for reservation at that time. Conditional formatting was applied to the table to show this availability as a gradient. Slots with the darkest gray represent times with no rooms available, whereas slots with the brightest green represent times with all rooms available.

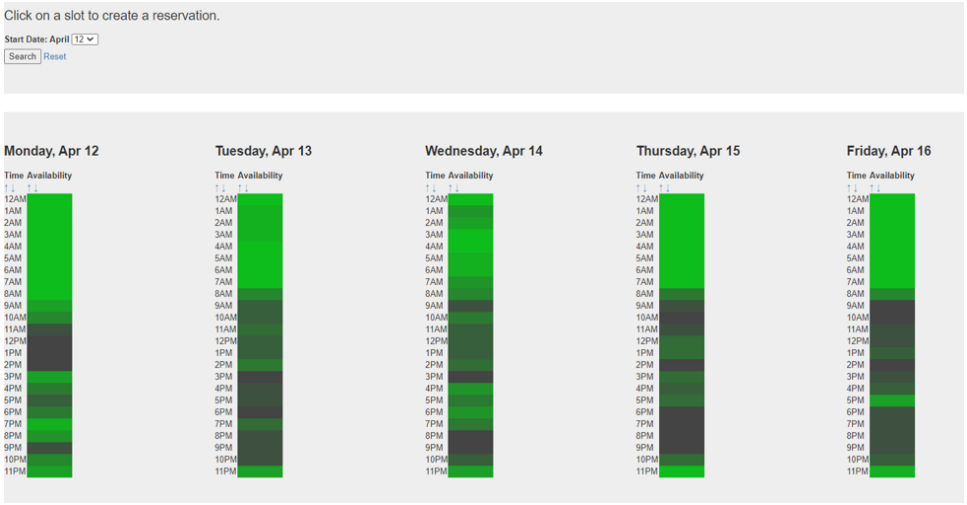

Figure 2.2: Screenshot from the Ruby on Rails implementation of the prototype for use in the User Study.

When the user first enters this page, the filter is automatically filled with the current date. The next five days, beginning with the current date, also appear automatically. This was implemented to eliminate that obstacle to the user. It also removes this implementation further from the concept of querying and more towards the concept of browsing. To query a different date, the

user selects a day from the dropdown menu and clicks 'Search'. This generates the same view, but beginning with the selected day.

The Suggestions Panel present in the design in Figure 2.1 was not included in this implementation. As this project went on, more and more focus shifted onto the human-computer interaction aspects and off of the machine learning aspects. Additionally, this would simplify the user study for the participants, since all the solutions would have the same basic features to compare. The implementation also lacks duration and time specifications. This is because, due to time constraints, the current time bar was not added to this interface. The duration was not included because for the purposes of the user study, reservations were limited to one hour to simplify the evaluation across all three methods.

To reserve a room, a user clicks on one of the colored boxes. This action redirects the user to the Create Reservation page, seen in Figure 2.3. The form is automatically filled with the start date, start time, end date, and an end time. Ideally, the room selection would have been limited to the number of rooms available; however, this was not implemented due to time constraints. The user also fills in the Subject, Name, and Email form fields to create their reservation. In a real solution, that information would be used to display the current user of the room outside the room itself. The contact information would be used to send confirmation emails or calendar invitations once the reservation is submitted. The user submits the reservation information for creation by clicking "Create Reservation." Then, a confirmation message appears and the user can navigate back to the start.

Figure 2.3: Screenshot from the Ruby on Rails implementation of the prototype for use in the User Study.

As the focus of this project is to assess characteristics of the application's interface, a user study was conducted on the implementation of multiple solutions. In a user study, volunteers interact with an application or graphical user interface model while answering questions and commenting on their experience. User studies are crucial for discovering issues with an interface design. Often, developers overlook these issues unintentionally; since they designed and/or implemented the application, they are uniquely experienced with the interface in a way that their users are not. Having an inexperienced user interact with an application will quickly reveal how intuitive the design is to navigate and use. Applications with difficult interfaces will go unused, and the service will not be provided to users. Therefore, evaluating an application's interface is an integral part of the development process. For the purposes of this project, a user study that compares multiple solutions will reveal characteristics that make a difference in how the user experiences a reservation system.

The user study took place as a series of interviews and surveys. Participants were college students and everything took place virtually due to COVID-19 restrictions. Each user interacted with three solutions: a Google Calendar and Google Forms solution, a system similar to the Zachry Event Management system, and my proposed solution. For each solution, the user was given a personal schedule to work around, with items such as classes or meetings. The schedule was displayed graphically as it would appear on Howdy or Google Calendar, with multiple days displayed vertically. The participants were then given a series of tasks, drawing from the case scenarios described in Section 1.4. They will be asked to schedule the soonest available option. Then, they will be asked to schedule a session during a week with many reservations already made. Finally, they will schedule a session with few restrictions, on a day with few commitments.

Before, during, and after these interviews, the participants were asked questions about their experience with study rooms and reserving them. Before the interview, they were asked how frequently they utilize the study spaces on campus and ask for their reasoning. This establishes how familiar the user is with these web-based applications, and any reasons why they do or do not utilize these on-campus resources. During the interview, the users were encouraged to describe their thought process and ask any questions they have. After the interview, they will answer questions to compare the solutions that they experienced. They will choose which view they preferred for browsing, which solution was best for each case scenario, which query options they thought were most important, and more. A full list of questions for the user study can be found in Appendix A.

3. RESULTS

3.1 User Study Results

3.1.1 Setup

A User Study format was chosen for this research because participants were evaluating implementations of an application for human-computer interaction. This is the traditional approach to testing software interfaces, as having a non-developer attempt to use the interface will quickly reveal problems. In a user study, participants are asked questions before they use the app to determine their previous experience level. While they use the app, they are encouraged to ask questions and make comments, while also answering qualitative questions about their experience. Finally, questions are asked afterwards about their overall impressions. In this case, the post-study questions also had participants compare the different methods of reservation. This was an appropriate method of evaluation since the goal was to judge the usability of the different implementations of study room reservation systems.

The participants for this study were college students. As this study primarily focused on reserving study rooms in an academic setting, this was the most appropriate audience. Many of the participants had prior experience with similar systems, and all of them had opinions about how they liked to study. In a simple user study, around five participants are necessary to discover the major flaws in an application interface. However, with the comparison component in this study, the goal participation was 15 people.

While initially planning to conduct this study in virtual interviews, scheduling conflicts and time constraints sparked a transition to asynchronous surveys. Detailed instructions were added to the application and the Google Form which collected the responses, and the research conductor made herself available for any questions via phone or email. This was successful, as participants were able to complete the study with little confusion and give meaningful feedback.

3.1.2 Execution

The structure of the user study was as follows: users would reserve a study room according to the three Case Scenarios described in Section 1.4, and do this for each of three methods. Method 1 simulated a system using Google Calendar and Google Forms, seen in Figure 3.1. Participants could see times when no rooms were available on the calendar, find a time that would work, then request that time through the Google Form. The decision to only show unavailable times on the calendar was made in an effort to simplify the visual and remove clutter.

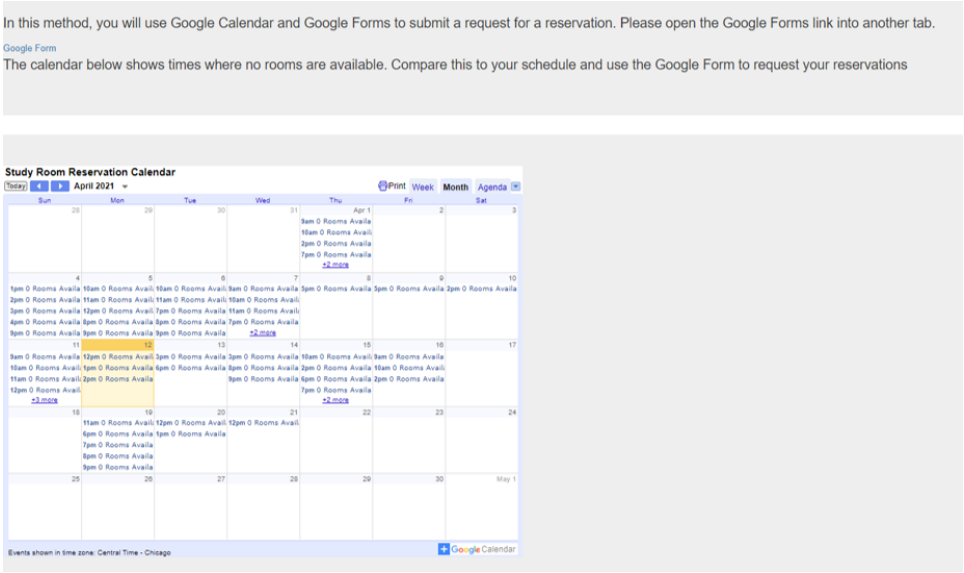

Figure 3.1: Method 1: Google Calendar and Google Forms implementation, similar to performing arts music rooms.

Method 2 simulated a system like the Zachry Event Management System or the reservation system used by libraries on campus, and is shown below in Figure 3.2. In this implementation, the user submits a date and is shown availability in a table. Rows represent rooms and columns the time of day; an entry is green if the room is available at that time, and gray if the room is not available at that time. This implementation shows only one day at a time, and the user can change this day through the input. The user clicks on one of the boxes to be taken to a prefilled Create Reservation page.

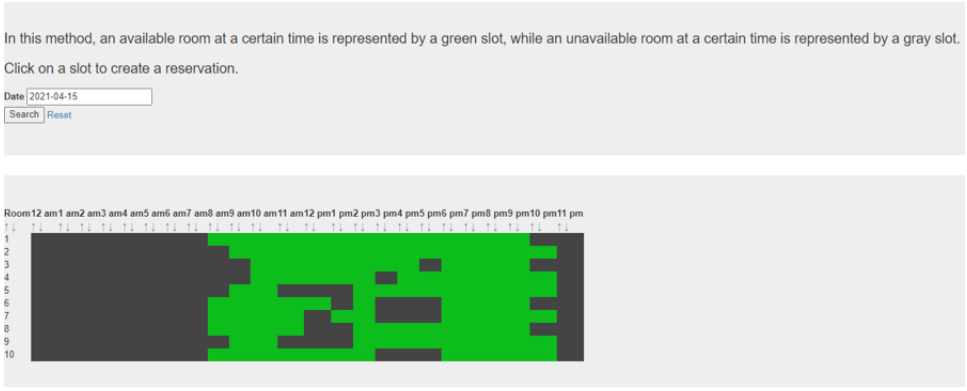

Figure 3.2: Method 2: Hourly availability for rooms on one date, similar to Zachry study rooms.

Finally, Method 3 simulated the proposed solution. Upon opening it, the user sees the availability for the current week, shown in Figure 3.3 below. This solution shows dates and times as a personal weekly calendar would. Availability is defined by number of rooms available and shown through a gradient: the brightest green represents when all rooms are available, and the darkest gray shows when no rooms are available at that time. Like in Method 2, the user clicks on one of the boxes to be taken to a prefilled Create Reservation page.

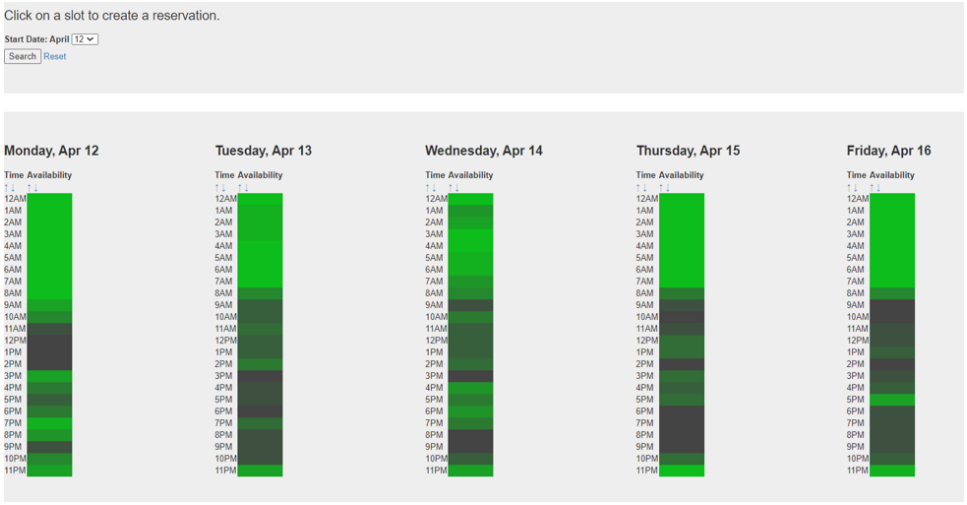

Figure 3.3: Method 3: Hourly availability gradient for week view, proposed solution.

The user was also given an instruction sheet with a class schedule to work around. The full instruction sheet can be found in Appendix B. It also defines the assumptions that the program makes in order to put all three methods on an even playing field. The Google Form through which the users submitted their feedback contained sections for the initial consent form, the pre-study questions, the study questions for each section, and then the post-study questions.

The Create Reservation page was the same for Methods 2 and 3, while a Google Form with the same fields was used for Method 1. This page can be seen in Figure 2.3.

3.1.3 Results

Seventeen students participated in this user study, which exceeded expectations. First, participants were asked questions that assessed their studying habits and experience with reservation services. According to the first demographic question, “What is your major?,” 65% of participants were engineering majors. As shown in Figure 3.4, public spaces that do not need to be reserved were more frequently used than the reservable spaces in either the library or building spaces.

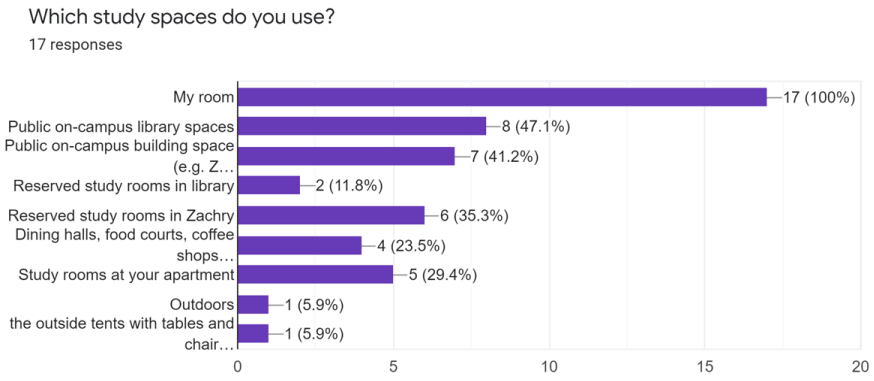

Figure 3.4: Which study spaces do you use?

According to answers to the question "Which is your preferred study space and why?", 65% of participants said their room or apartment was their preferred study space. Four out of these eleven cited the COVID-19 pandemic as their reasoning, while the others cited convenience. The full responses to this and other study questions can be found in Appendix C.

The next two questions relate to prior experience participants may have with reserving study rooms. According to Figure 3.5, 59% of the participants had prior experience with the Zachry Event Management System, and 29% of the participants had prior experience with the reservation system for the library.

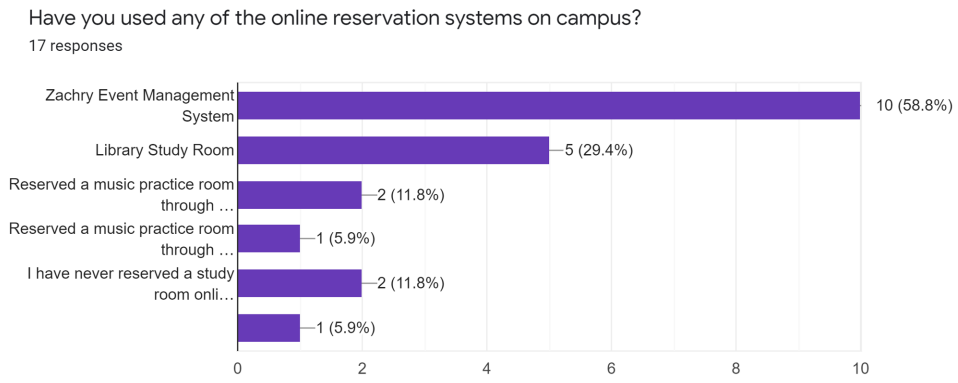

Figure 3.5: Have you used any of the online reservation systems on campus?

According to the answers displayed in Figure 3.6 below, the highest-ranked factors for study room scheduling were Building Location, Time of Day, and Duration of visit.

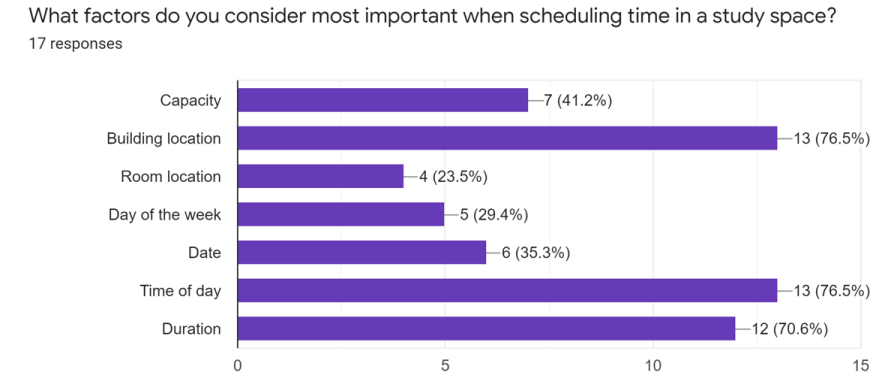

Figure 3.6: What factors do you consider most important when scheduling time in a study space?

When evaluating Method 1, participants liked that the visualization allowed them to see availability for a month at a time. Since the participants were familiar with the tools, they did not have much confusion utilizing this solution. The participants did not like how the form does not

automatically reserve your room and has to be opened as a separate tab. They also found issue with the calendar listing unavailable times as opposed to available times. According to Figure 3.7, the users felt the easiest scenario to accomplish with this method was the third by far, with few constraints.

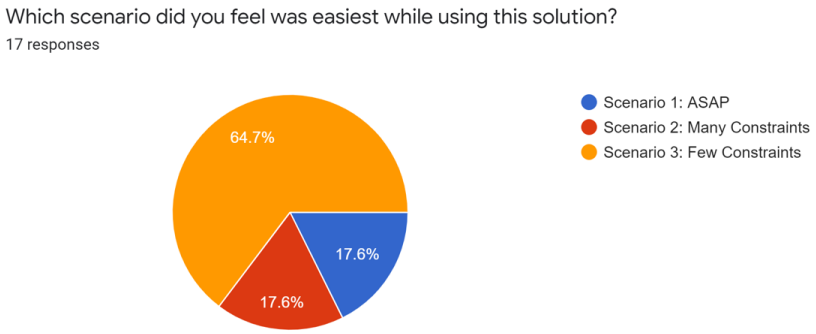

Figure 3.7: Method 1: Which scenario did you feel was easiest while using this solution?

When evaluating Method 2, participants liked that the implementation was detailed, clear, and simple to use. Participants mentioned that this format was familiar to them by comparing it to the library or Zachry systems they had used before. Participants did not like that the boxes were small and slightly hard to read. According to Figure 3.8, the users felt the easiest scenario to accomplish with this method was the first, finding the soonest available reservation, although the second scenario was close behind.

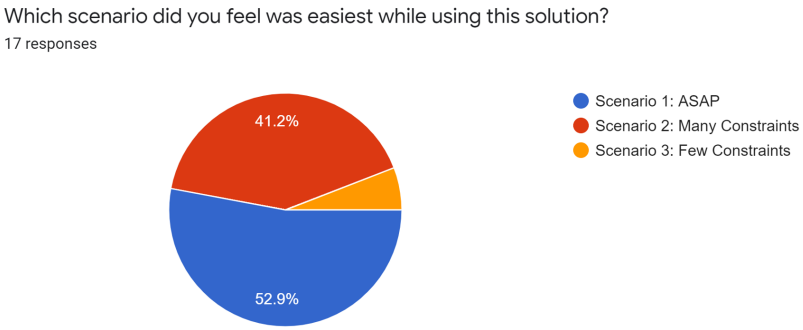

Figure 3.8: Method 2: Which scenario did you feel was easiest while using this solution?

When evaluating Method 3, participants liked that the visualization covered multiple days, and the ease of determining availability from the gradient. Participants did not like that it lacked the specificity of room-level detail like Method 2 had. According to Figure 3.9, the users felt the easiest scenario to accomplish with this method was the third by far, with few constraints.

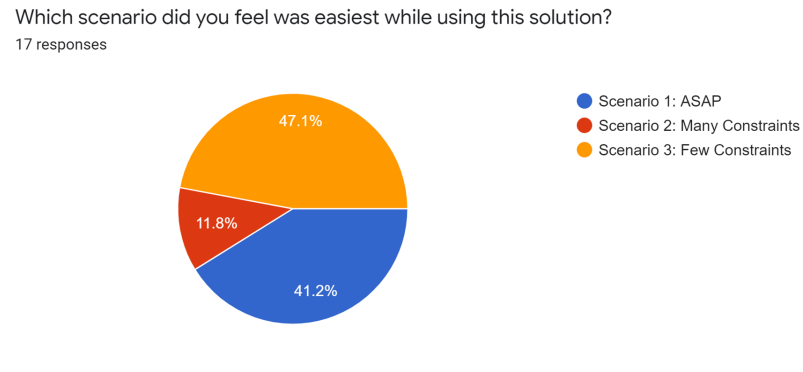

Figure 3.9: Method 3: Which scenario did you feel was easiest while using this solution?

Figures 3.10, 3.11, and 3.12 show which solution was evaluated as the best method for each Scenario. Method 2 was held the strong favorite for scenarios 1 and 2, while Method 3 was

strongly preferred for scenario 3.

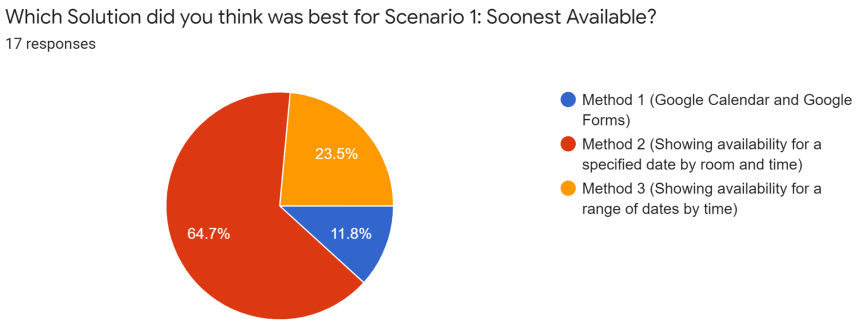

Figure 3.10: Which solution did you think was best for Case Scenario 1(soonest possible)?

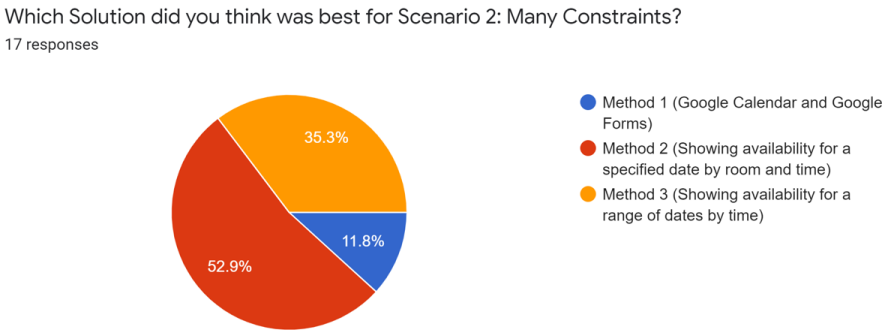

Figure 3.11: Which solution did you think was best for Case Scenario 2 (many restrictions)?

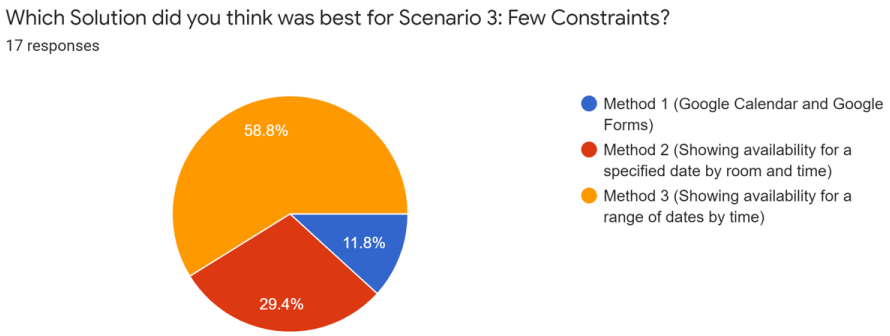

Figure 3.12: Which solution did you think was best for Case Scenario 3(few restrictions)?

Finally, participants selected their favorite method and gave their reasoning. As shown in Figure 3.13, 59% selected Method 2 as their favorite, while the rest selected Method 3. Participants who selected Method 2 cited the clarity and ease with which they could see the information. Those who selected Method 3 cited that it was easy to read, showed more times, and was easy to compare to their schedule.

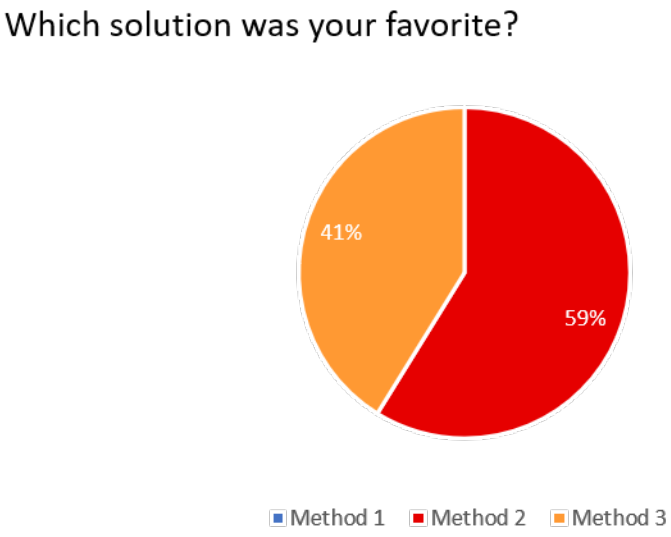

Figure 3.13: Which solution was your favorite and why?

4. DISCUSSION

4.1 Results Interpretation

The demographic questions provided insight into the user study participants' background with room reservation. It was not expected that the majority of participants would have selected their room as their preferred study space. However, considering how virtual courses and the pandemic have affected, it makes sense. Participants also cited that their device setup kept them at home. Participants also highlighted the most important scheduling factors to them, which matched expectations. Room location was expected to be ranked low, and it was ranked lowest; time of day was expected to be ranked highly, and it was ranked highest, tied with building location.

Fifty-nine percent of participants had used the Zachry Event Management System to reserve study rooms previously. This aligns with the fact that 65% of the participants were engineering majors, and thus likely to spend more time in the Zachry building. The library study room reservation system had been used by 29%. Combined with the Zachry system usage, the familiarity participants had with an availability-by-room interface created the expectation that they would find Method 2 easy to use, which they did.

Method 1 was the most disliked among the three methods due to the inconvenience of opening another application for a form and confusion that came with the availability portrayal. In fact, it was unanimously selected as least favorite by participants. They did, however, express that their familiarity with the tools helped them slightly to navigate that solution.

Methods 2 and 3 were well received by the participants. As many of the participants had used a similar tool before, Method 2's visualization was familiar and thus intuitive. When a participant chose Method 2 as their preferred method, they cited that they liked the detail and the simplicity. When participants evaluated which method was best for which scenario, they chose Method 2 for the scenarios that required a closer look at the availability at specific times, since the scenarios carried more restrictions. Participants would look for a specific time on the method,

and the fact that Method 2 gave them a simple yes or no as to whether a room was available at a specific time made it ideal for those scenarios. Participants were expected to be familiar with this solution due to the answers from the demographic questions.

Participants that chose Method 3 as their preferred method thought that it was easier to understand and compare with their schedule, while appearing to give more options. Method 3 was largely preferred in Scenario 3, which offered the least restrictions. With fewer restrictions, users likely would want to compare a few options over multiple days. Participants in that case would want to see how the reservation would look on their schedule, and Method 3 is the easiest to compare with a personal calendar. The prototype method provided a user-friendly solution for cases where users are looking for general availability over the course of multiple days.

4.2 Methods Reflection

While live interviews may have yielded more detailed results, the quality of evaluation that came from asynchronous surveying was more than sufficient for this study. Most participants found the instructions clear and the purpose intuitive.

Much of the negative feedback from participants came from simple web design complaints. Small boxes and poorly aligned text distracted from the participants' experience and the goals of the study. While these issues may not speak directly to the intended differences between the methods, they did differentiate them. However, Method 2's formatting issues did not detract from it being preferred by 59% of participants.

4.3 Future Work

One participant suggested that a mixture of Method 2 and Method 3 be created, such that once a user decided what day to schedule from the Method 3 weekly view, they could be directed to the Method 2 daily view to select a specific room and time. This combined solution could provide a solution for people who have few restrictions and for people who prefer the detail from solutions like Method 2. The weekly view for room reservation has potential to be expanded for a more intuitive reservation experience.

5. CONCLUSION

The proposed solution succeeded at its goal: to be a better browsing solution than current systems. While it was not the favorite in all cases, participants found the gradient availability easy to interpret and a weekly view useful for scheduling. With few restrictions, users found the prototype to be more intuitive to compare to their class schedules and look for general blocks of time.

The existing solution simulated with Method 2 in this user study held strong favor with participants. Previous experience with similar applications put users at ease, and the detailed clarity of the daily view proved more significant to users than anticipated. The existing solution simulated with Method 1 in this study was not well received, despite the fact that it was composed of familiar tools. To implement an effective reservation strategy using Google Calendar and Google Forms, or other free-to-use tools, may require creative arrangement to improve user experience and more attention by system managers than is feasible.

This study shows that there is definite potential in integrating more browsing features to scheduling systems. Combined with the accepted, detailed implementation, the proposed and tested solution improves the reservation experience.

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APPENDIX A: USER STUDY QUESTIONS

Pre-Interview Questions

1. Which study spaces do you use?

    - My room
    - Public on-campus library spaces
    - Public on-campus building space (e.g. Zachry, Memorial Student Center, etc)
    - Reserved study rooms in library
    - Reserved study rooms in Zachry
    - Dining halls, food courts, coffee shops, restaurants etc.
    - Study rooms at your apartment
    - Other

2. How frequently do you use the study spaces available on campus?

    - 2+ times per week
    - About once a week
    - About once a month
    - Only for finals or big projects
    - Only for group meetings
    - I have used a study space on campus once or twice ever
    - I have never used a study space on campus
    - Other

3. Which which is your preferred space and why?

4. Do you reserve these spaces in advance, and if so, how do you do so?

5. Have you ever used any of the online reservation systems for scheduling sessions on campus?

    - Zachry Event Management System
    - Library Study Room
    - Reserved a music practice room through the front desk at the MSC, Commons, or Hulabaloo
    - Reserved a music practice room through Google Forms through the College of Liberal Arts
    - I have never reserved a study room online
    - Other

6. What do you use study rooms for?

    - Individual study
    - Group study
    - Socializing, relaxing, or eating
    - Organization meetings
    - Taking exams
    - N/A
    - Other

7. What factors do you consider most important when scheduling time in a study space?

    - Capacity
    - Building location
    - Room location

- Day of the week
- Date
- Time of day
- Duration
- Other

8. What do you expect to see when you go online to reserve a study room?

Interview Questions (For Each Solution)

1. What are your initial thoughts when you view this page?
2. What information does this page give you when you enter it?
3. What features on this page do you have questions about?
4. What did you like or dislike about using this solution?
5. Which case scenario did you feel was easiest while using this solution?
6. What do you think this solution does well?
7. What do you think this solution lacks or does poorly?
8. Did anything about this solution surprise you?

Post-Interview Questions

1. Which solution did you think was best for Case Scenario 1(soonest possible)?
2. Which solution did you think was best for Case Scenario 2(many restrictions)?
3. Which solution did you think was best for Case Scenario 3(few restrictions)?
4. Which solution was your favorite and why?
5. Which solution was your least favorite and why?
6. After using these solutions, have your views on scheduling factors changed in any way? Did this experience confirm or contradict them?
7. Was there a feature you expected these solutions to have that none of them had?
8. Do you have any suggestions for ways to improve any of these solutions?
9. Do you have any additional thoughts or questions regarding study room reservation?
10. Any comments or questions regarding this survey?

APPENDIX B: USER STUDY INSTRUCTIONS

Information and Schedule

In this study, you will be reserving study spaces in a building on campus that has 10 study rooms available to reserve through their online system. For the purposes of this study:

- The capacity of the room will be adequate for your reservation
- All rooms have the same resources and furniture
- You will be asked for your email and name to simulate true-to-life reservations, but these will NOT be recorded—feel free to put any text you like if you are uncomfortable entering that information
- The application will claim to send you a confirmation email after each reservation—you will not receive these
- Reservation start and end times will be rounded to the nearest hour for simplicity
- We will only be considering the month of April

For each Method or Solution, you will reserve a room for each of the following scenarios:

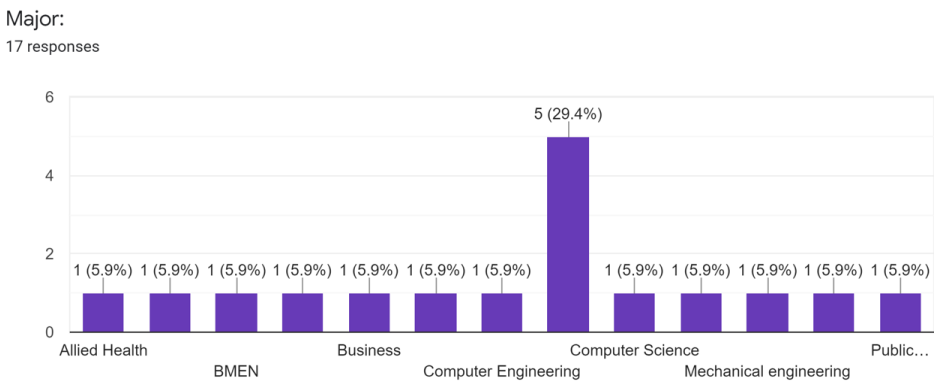
1. Soonest Available: You get out of your second class on Monday and decide you want to schedule a study room to do some homework in until your next class. Schedule the soonest available reservation.
2. Many Constraints: You want to schedule a study room for this week to meet for a group project for the online class you take second on Tuesdays. Schedule a reservation this week at a time where other people would also probably be available.
3. Few Constraints: You have a test in two weeks and want to schedule a study room to prepare for it. Schedule a reservation some time in between now and the test.

IMPORTANT: Please follow along with the Google Forms Study Questionnaire. Do not skip ahead.

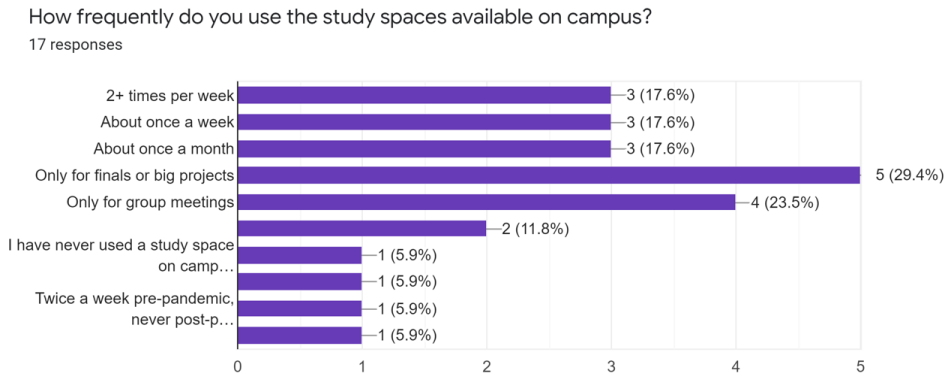
Here is your class schedule for the purpose of this study. The pink boxes represent classes that are in person in the same building you are scheduling in. The dark blue boxes represent classes that are in person in another building on campus. The light blue boxes represent classes that are fully online.

APPENDIX C: USER STUDY RESULTS

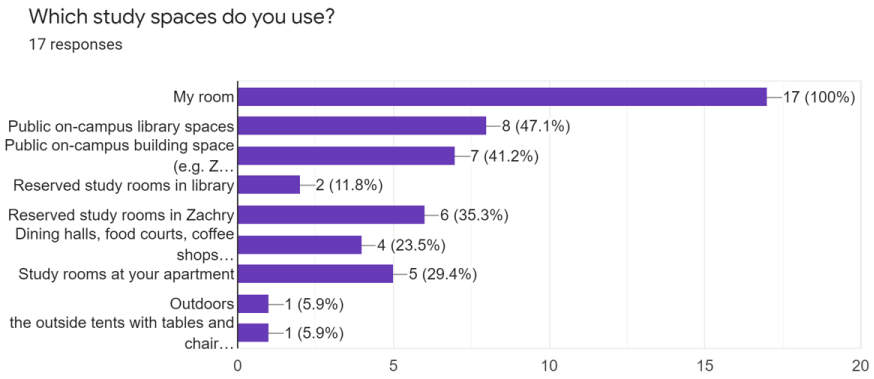
What is your major?



How frequently do you use the study spaces available on campus?



Which study spaces do you use?

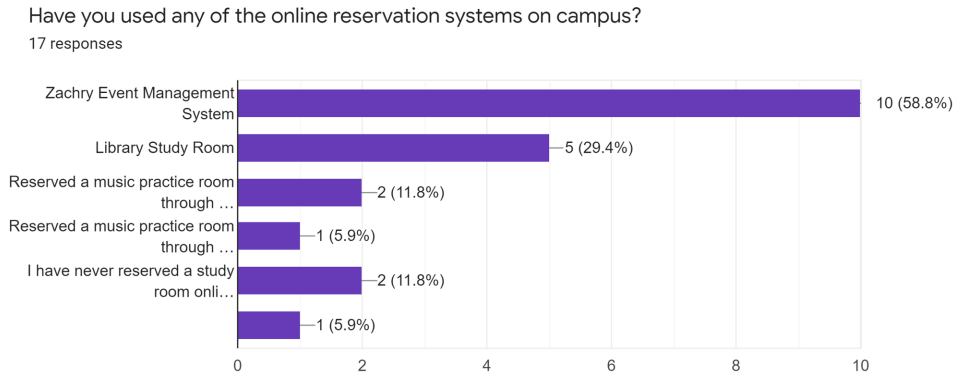


Which is your preferred space and why?

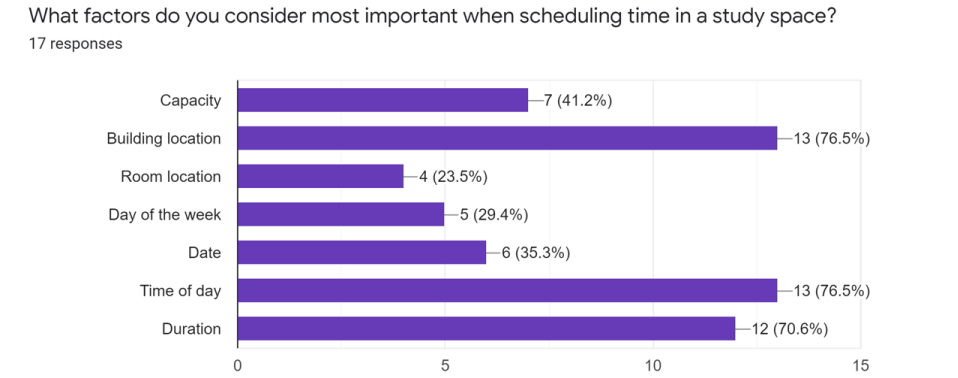
- My room since I'm free to use it whenever (and I don't need to make any extra trips)
- Evan Library 5th floor because of the environment
- My apartment because I have more space and all of my materials and equipment.
- Public on campus building space, easiest to find a table to use
- My room since I feel a lot more comfortable in there and feel more safe as I do not have to worry about COVID.
- My room because of COVID
- My room. Because it isn't easy to bring my second monitor around town
- My room, due to the pandemic
- Love coffee shops because the smell keeps me cozy and the background noise keeps me concentrated.
- My room is the preferred space because better technology, secure wifi, and free snacks from my fridge.

- My room
- My room–I live in a single and it is usually clean
- I feel like I can focus the most while studying at the library
- My apartment right now during covid.
- Currently it is my room, mainly because of the setup I have here and the fact that most of my classes are online so going to campus requires extra effort.
- Zachry Study rooms because there is a lot of lighting and space.
- Public on-campus library spaces: quiet, few distractions, not too lonely, no reservation required

Have you ever used any of the online reservation systems for scheduling sessions on campus?



What factors do you consider most important when scheduling time in a study space?



Method 1: What do you think this solution does well?

- You can reserve a large chunk of time for the room.
- It looks very nice and I like how it can pull up the google calendar for a better view.
- I think this solution is good at visually showing the full month
- its easy to glance at the calendar and see the times where rooms are not unavailable
- I think it provides a sufficient and efficient way to get a study room.
- shows you all the available times
- I like the ease of submitting multiple reservations. I like that you can do what ever times you want. though I guess no constraints is bad too. Cause you will have some one who will reserve for way too time.
- Allows you to visualize a large amount of data on one page
- It has a cool way of showing the times (week/month/agenda)
- This solution helps me plan reservations ahead of time and make reoccurring reservations.
- Tells you when not to go
- I can see where there are big blocks of time where things are available, if I only see a few entries in that day. Also, the design is very simple, and I can see the whole calendar.
- I honestly do not think this solution does much well, as it feels fairly flawed.
- The ease of access when opening up the google form for method 1.
- I think the thing that this solution does well is it uses 2 things that almost everyone in college is familiar with: Google Calendar and Forms.
- I think its good at providing information about when you can't get a room and the times.

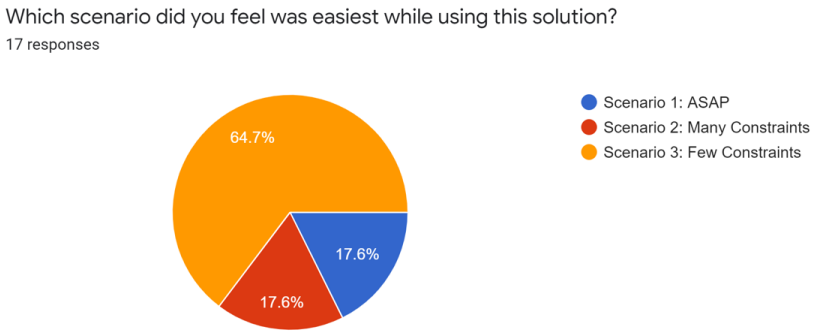
- Shows calendar view which looks similar to schedule, Google form is simple to fill out

Method 1: What do you think this solution lacks or does poorly?

- The form won't check immediately whether the time you selected has the room available.
- I do not like how it tells you when rooms are unavailable but doesn't tell you when the rooms are available.
- This solution could be better at showing additional times when some rooms are available
- the times could be easier to read if they were not the unavailable times
- N/A
- doesn't have enough study times, seems to fill up much quicker, the system to select the option through forms doesn't seem efficient
- It is not intuitive, that you only see times you can't get rooms. And that you can't see what rooms are reserved ever, so you could get doubly booked pretty easy. It should at least send you an automated room if we can't tell that. You also can't tell where any of these rooms are, so I think it would be easy to be lost, especially as room count grows. Also the layout is ugly and I don't know what do when I see it. And the default calendar being the month is wrong, the week view is much more helpful. I mean, still the badness of only showing times that are wrong, but it is much better. And you shouldn't hide the better way behind a button push. Back on the time, it is very easy to make a mistake with it and do something you did not mean, you might put a wrong date on accident and reserve a room for a whole year. and that is not good.
- Bigger calendar squares would be helpful compared to clicking to see more
- There is very limited availability to begin with since the times offered only have one day with evenings available, and one with mornings available.
- Making a reservation through google form is not the most UX friendly way to reserve a room.

- What rooms are available
- There are no room numbers–I have no idea if the room I chose on the google form is available. Also, I think having a full timeline of the day is essential, especially if it is a scheduling hub that only gives you what is not available.
- I think the method of communicating which rooms are open and when is very flawed and thus makes scheduling accessibility difficult.
- I do not know what rooms are open for method 1 and there is not much detail if I will even get the room.
- Like I said above, the fact that seeing the availability and scheduling the room are done through two different tabs is inconvenient and makes it harder to coordinate since you must also check your availability in your schedule.
- I wish it provided options to view availability versus not available rooms.
- It is confusing and requires the user to think about what times are outside the unavailable times rather than to just see available times

Method 1: Which case scenario did you feel was easiest while using this solution?



Method 2: What do you think this solution does well?

- It clearly shows the availability of rooms without having to do too much extra work. Information that is known to be selected is also already filled in in the form.
- Very easy to use
- I think it is very easy to see a full day's schedule and it stays in the same website/tab
- was easy to see what space i have visually available on my schedule and compare to the green spaces on the signup
- I think it provides a unique way to book these study rooms.
- Better to select times and find available times for everyone
- Very nice for simple one day sorts of reservations. Tells if there are rooms for a time or not. The autofill on the form is nice.
- Specificity
- It fills out the information for you by simply clicking one green square, pretty cool.
- Helps me find a study room on very quickly like the day of or in the coming days.
- The times of an individual room
- It lets you see overall availability, room numbers, and duration of availability. It also lets you see when the rooms start being open and when they close. Also, the automatic filling was much easier than Method 1's google form.
- I think this solution communicates exactly where and when rooms are available very well, letting students plan ahead how long they would like to stay and where exactly they want to stay
- Easy to see what times are open to reserve for with the design lay out.

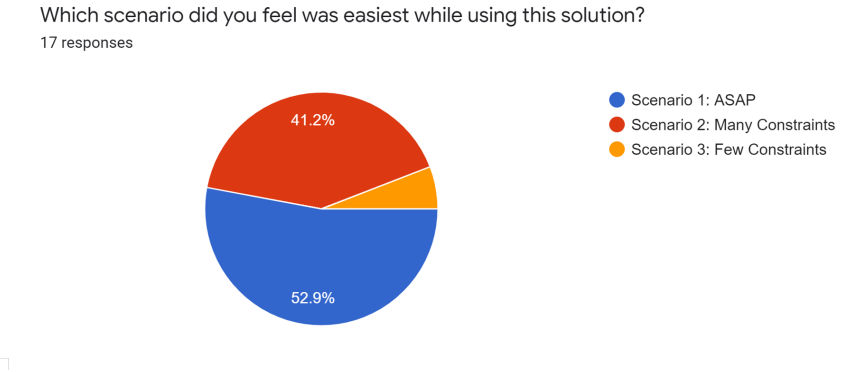
- I like the view of what's available and reserved for this solution. It is what I expect to see when reserving rooms.
- I think it shows when you can get a room clearly.
- Displaying available times, available rooms

Method 2: What do you think this solution lacks or does poorly?

- It doesn't show what end times are available (so you could create a reservation that extends into another reservation).
- I think this solution lacks detail that would be useful in planning something far in advance
- some gridlines on the slots would make it way easier to see individual slots and click on
- It could provide a better way of showcasing which rooms are available and which times they are available.
- The selection box is too small, cant see what I'm clicking super well
- There is no reason for it not to have the room reservations for today not to open automatically when you get to the web page. It makes the instructions much more understandable.
- Not so good if you don't have a specific day in mind. It is overload in that it has too many times in one day, and underload in that you can only see one day at a time.
- I don't like that the form doesn't navigate you back to reservation site.
- Legibility
- It's not quite there on design
- It does not show you multiple rooms that are available and it only lets me do one day at a time.
- Lacks calendar view
- It lacks visual clarity. Also, I think it could use a clearer date input method–like a calendar where you can click on the date instead of having to type it in. I just feel like I would write the wrong date in my initial search.

- I do not think the solution does anything poorly, but I would have liked to not have been taken to another page when trying to schedule, or the date being reset to an earlier date in the month instead of at the time requested.
- It was nice seeing what times were available but I am not sure if this applies to to see if the rooms are available at that same time.
- I think that the one thing that this solution lacks is the ability to select multiple successive timeslots to reserve. You have the option to change the end time on the reservation screen which is nice, but being able to do so from the main screen would be better.
- I think it doesn't allow you to pick different increments of time (like 30 minutes)
- Does not include day of week or information about rooms, did not understand arrows

Method 2: Which case scenario did you feel was easiest while using this solution?



Method 3: What do you think this solution does well?

- It shows multi-day availability (although not for the entire week).
- It is very appealing and aesthetic
- It showed all the options available and was very easy to navigate and compare.
- very easy to find slots when you know you have lots of free availability
- Present a clear and visually appealing way of booking a study room and getting this important resource.
- Shows how many rooms are left and available, range of times, many rooms available, can select a block of hours
- A good amount of information. Just having times and seeing the whole week is really nice. Not as much information overload like with method 2. The autofill is still nice. It automatically opening up when you see the page is nice (cough method 2 cough).
- Present multiple days on one page
- It gives you a good idea of overall availability...
- This sections does well in helping me find study rooms immediately and in the near future. It is a painless process to schedule a room and pleasingly displayed.
- It tells you when to go in a week for availability.
- You can see big blocks of availability. Also, it is very easy to find the date and time you are looking for because it is so clear.
- I like how the green-gray gradient level communicates if one or more room is available, and helps the student guess around how many rooms are reserved.

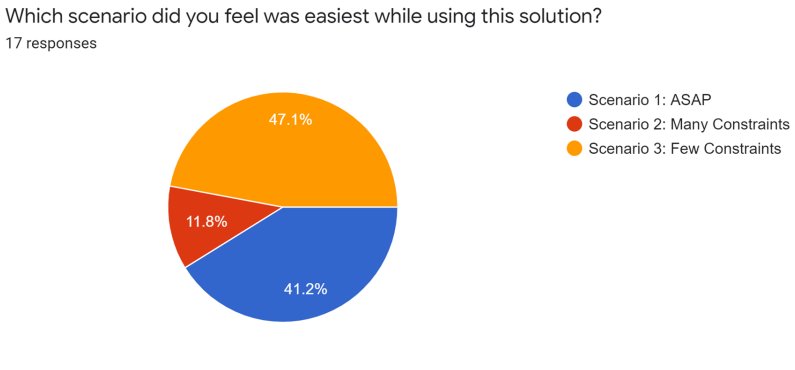
- This really makes it easy to see the the free time throughout the specific day I want to reserve for.
- I think this solution does similar things to solution 2, but surpasses it in the fact that it already shows users a sample of the week.
- I think it shows availability really well.
- Displaying days of week and available times

Method 3: What do you think this solution lacks or does poorly?

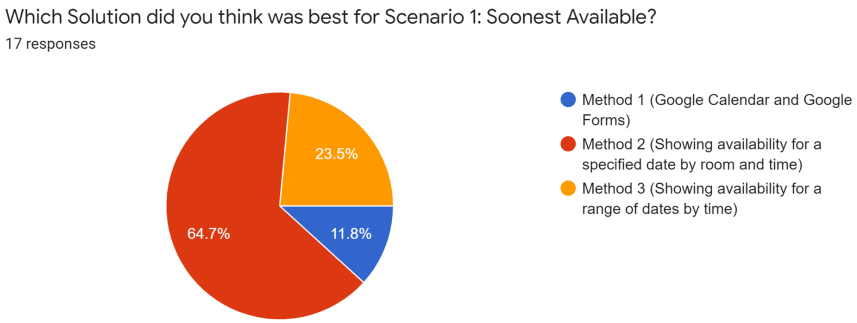
- It doesn't show room availability. I have no idea if I'm reserving a room that is already reserved. Additionally, I don't know if a green gradient means the same room I want is available.
- I think this solution lacks some clarity in duration of study times
- lack of clarity with the levels of attendance with the gradients
- N/A
- Cursor is too small, can still schedule during a grey area, not sure how many rooms are available total
- Clicking the right time slot is a bit weird. Maybe spacing out the times a bit more in the columns could help that.
- Having no room information and still expecting me to choose a room is dumb.
- I don't think it would work well if you have people reserving for more than one hour at a time.
- A key/legend
- ... I would just love it to be a bit more detailed
- This solution lacks the ability to make reoccurring meetings automatically.
- If you want a specific room, it's probably tough to see its availability.
- No specific room numbers, a color-based judgement of sparsity.
- I think this solution–while far better than Solution 1–suffers from the same problem of not specifying exactly what rooms are available at a certain time.

- Maybe putting the reserved room first so that I can see which room has the least amount of reservations instead of guessing which room would be open.
- The thing that this solution really lacks is the option to see which rooms you can reserve. Even when you click on a greyish green block, all of the rooms are available for reservation even though obviously not all of them should be.
- I wish it showed me what room and the capacity.
- Does not include specific rooms that are available, so I do not know which room to put down, dates do not go that far into the future

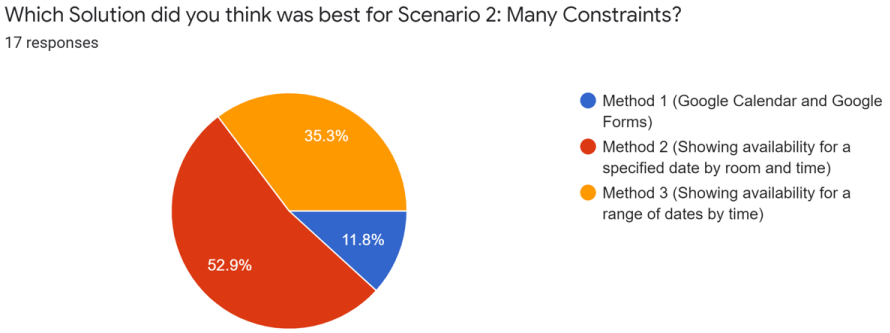
Method 3: Which case scenario did you feel was easiest while using this solution?



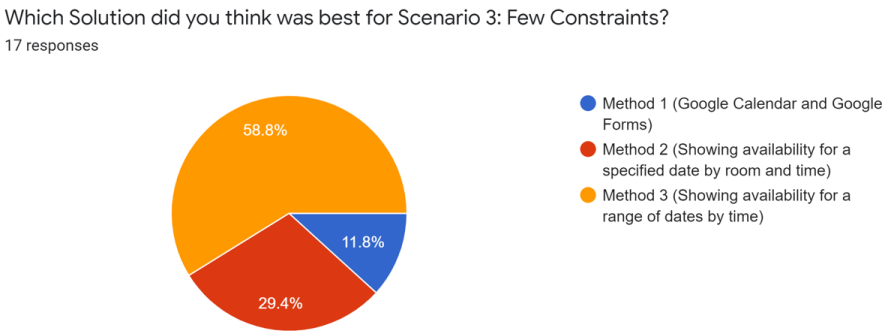
Which solution did you think was best for Case Scenario 1(soonest possible)?



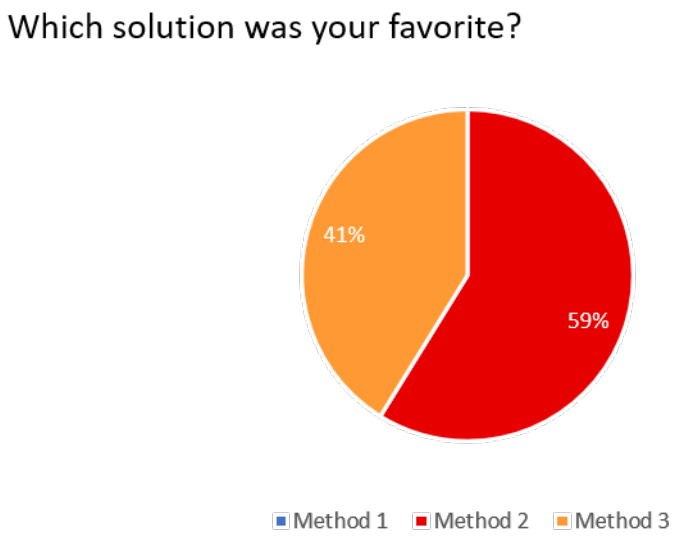
Which solution did you think was best for Case Scenario 2(many restrictions)?



Which solution did you think was best for Case Scenario 3(few restrictions)?



Which solution was your favorite and why?



- Method 2 since it more clearly showed what room was available, when, and what date.
- Method 2. It is the easiest to understand and the easiest to see the availability of each room
- My favorite solution was method three because it was the easiest to read and quickly select dates/times
- method 2, it gives the most clear picture of what rooms are available when so you know exactly where you can be at what times
- Method 3 as I thought it did the best job of adjusting the way you can get a study room and making it more advanced and simple to navigate.
- Method 2, it was a lot easier to use and you can see a range of times and availability, also which rooms are and aren't available
- I guess method 2. It autofilled the most information for me. And I am lazy.

- Method 2 was easiest for finding both a particular room and time at once
- Loved the 3rd method because it gave me a broader range of options
- Method 2 was my favorite because it fits the way I would be scheduling a reservation, on the day of in between classes.
- I liked method 3 because its the one I would actually use. its easy to compare to my class schedule
- Method 2–I liked that I could see how long the rooms are available for. Also, I can see what rooms are available, so I know where to go when I get to the library.
- Method 2 because it gave information on the availability of all rooms at specific hours
- Solution 3 because it showed the available time in a graph that was easier to read.
- My favorite was solution 2. It was the only one that gave you a breakdown of which rooms were available on the specified date and it is the most similar to other reservation systems I've used in the past.
- I liked the last one, it was more clear what the different availability was.
- 3: included day of week and had vertical schedule view

Which solution was your least favorite and why?

- Method 1 since it was way too tedious to use in order to reserve a room. Plus there wasn't anything on the calendar showing when things were available.
- Method 1. It was very confusing for me to use. I could not figure out what times where available.
- Method 1 was my least favorite because there were so many elements and the google calendar only showed unavailable times.
- method 1, i really didnt like how the calendar says the rooms unavailable. if it said when rooms are available instead it would appeal more to me
- Method 2 as the method did not seem to work on my device, so I was not able to understand what it was trying to do.
- Method 1, there were many gaps for study times and everything was unavailable, doesn't say what rooms are available, weird hours
- Solution one is bad. two pages. only showing bad times. No autofill. It isn't good.
- Method 1 required too much external info
- Google Calendar and forms because there weren't any rooms available
- My least favorite was method 1 because I did not like the making a reservation through the google form.
- Method 1 seemed backwards to me in that I want to know the rooms that are open, not if they're closed.
- Method 1–I just really don't see the point. I want to know when rooms are available, not when they are unavailable. That doesn't really help me.

- I disliked Method 1 because it sent me to another page to fill out more information that the calendar neglected to tell me about–particularly in regards to when and which rooms are open for reservations.
- Solution 2 because you had to manually input the date to see the timeslots that were open where I needed to see multiple timeslots that are open on multiple days.
- Solution 1 was my least favorite. Using google calendar along with google forms could work in simple situations, but with 10 study rooms and needing to schedule a room for hours at a time it was the least effective solution.
- I think the google forms one was my least favorite, due to not being certain about whether I will be able to get a room at a certain time.
- 1: two separate pages and not showing the available times

After using these solutions, have your views on scheduling factors changed in any way? Did this experience confirm or contradict them?

- It confirms that I would rather push meetings or studying to the weekend (unless I had a date for the test, then I would push it closer to the day before I need to take the test). I have realized that I hate ambiguity when it comes to scheduling. I don't like when it's not clearly shown when a specific room is available on a specific date, time, and if the end time encroaches on any other reservations.
- It did not change my opinions because I have little experience with reserving study rooms.
- I found dates/times to be more important than almost any other factor.
- it confirmed that i want to know exactly what location i'm signing up to go to
- Yes, because it made me realize how hard it can be to schedule something in these rooms if you do not know what to clearly do.
- It solidified how much I really like method 2
- It definitely proved that the week view is superior. And autofill is great. I don't want to make choices in the form, I want the interface to do it for me so I can see it most simply visually, and I am less likely to make a dumb mistake.
- I realized I don't actually like the calendar visual
- I did like having three different views/methods that one could schedule a room. It would fit all types of students and their style of reserving a room. I would use one that just gives me a one day view but others may like seeing weeks or a month in advance.
- It affirmed my like of weekly spreads.
- I appreciate the one I use more. My university uses a scheduling hub very similar to Solution 2, so that is what I was used to and found easy.

- This confirmed my acceptance of the efficiency of my library's reservation system because it–a pretty similar replica to Model 2–is far better and more informative than other possible methods presented in this study.
- There was not much change, I can see how I may want to plan in advance for a room that I want to reserve early for studying more.
- They haven't changed; this experience confirmed them.
- I think I have realized there are a lot more factors that go into scheduling a room.
- No, this experience confirmed them